PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE HONORABLE BOARD OF PATENT APPEALS AND INTERFERENCES

In re the Application of

Steven J. Harrington	Confirmation No. 3224
Application No.: 09/851,210	Examiner: James A. Thompson
Filed: 05/07/2001	Docket No.: 98258-US-NP

For: **METHOD FOR COLOR HALFTONING WHEN UTILIZING REDUNDANT COLOR INKS**

BRIEF ON APPEAL

Appeal from Group 2625

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I. REAL PARTY IN INTEREST

The real party in interest for this appeal and the present application is Xerox Corporation, by way of an Assignment recorded in the U.S. Patent and Trademark Office at Reel 11805, Frame 750-751.

II. STATEMENT OF RELATED APPEALS AND INTERFERENCES

There has been one prior appeal as filed 12/29/05. The Office response was a "Re-opening of Prosecution after Appeal Brief", in the Office Action of 3/31/06, and with new grounds of rejection. There are no pending appeals, interferences or judicial proceedings, known to Appellant, Appellant's representative, or the Assignee, that may be related to, or which will directly affect or be directly affected by or have a bearing upon the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-16 are on appeal.

Claims 1-16 are rejected.

IV. STATUS OF AMENDMENTS

No Amendment After Final Rejection has been filed.

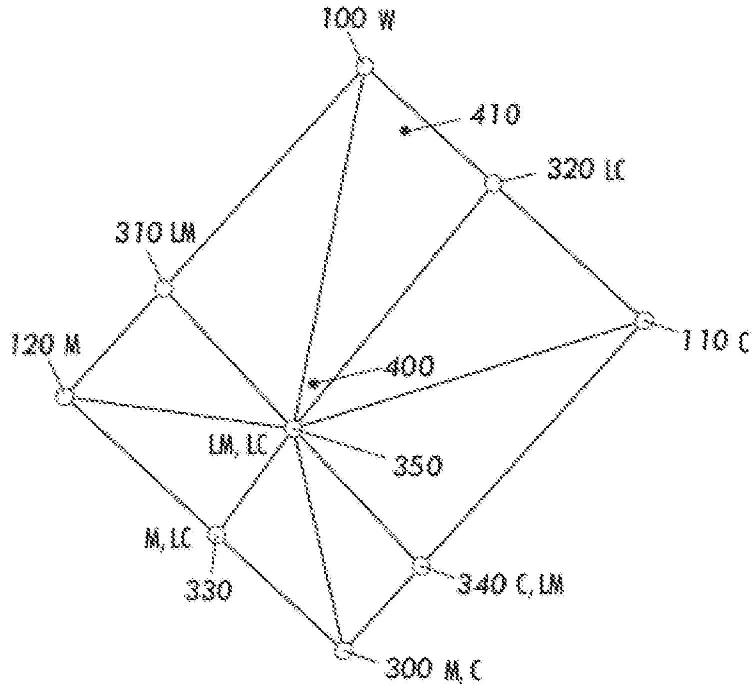
V. SUMMARY OF CLAIMED SUBJECT MATTER

The subject matter of independent claim 1 is directed to the utilization of redundant color inks with a methodology for identifying which ink combination from a multitude of possible choices is best utilized in rendering a given image (see page 1, lines 16-18, of the Specification as filed). As is well understood by those skilled in the art, to produce a desired color one can identify a tetrahedron in color space that contains the desired color. One can then produce the desired color by a proper combination of the four vertex colors that define that tetrahedron.

In general, there can be many possible tetrahedra that enclose a given desired color point. As is taught by the Applicant, **the best tetrahedron for such a point is the one that has most nearly the same luminance for all of its vertices**. This will minimize the luminance contrast in the halftone pattern that produces the desired color (see page 6 lines 21-24, of the Specification as filed). So the problem is then to tessellate (divide-up) color space into tetrahedra such that the vertices of the individual tetrahedra have localized luminance values (see page 6 lines 27-28, of the Specification as filed) (in particular page 6 lines 22-23 for support of "vertices").

Figure 4 depicts an undesirable tessellation approach applied to a two-dimensional color plane. [The color space has been canted slightly to emphasize the depiction of luminance variation by placing the highest points of luminance at the top, and the lowest points at the bottom of the depiction. The top of the data at vertex 100 being the lightest and the bottom of the diagram at vertex 300 being the darkest end of available luminance variations.] Please note the vertices in Figure 4 and Figure 5 are

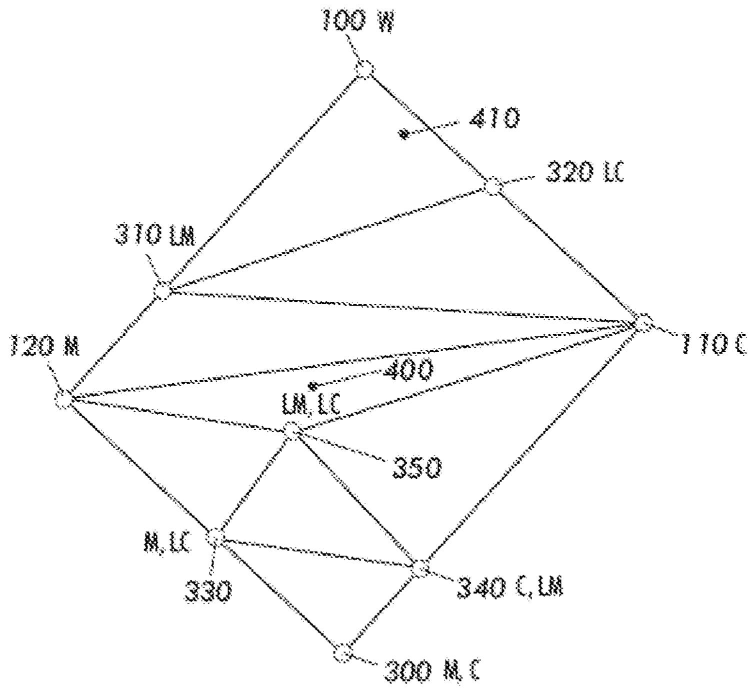
necessarily defined by the inks in the printing system (see page 4 line 20, through page 6 line 5, of the specification as filed).



The tessellation employed here consists of breaking-up the color space by defining non-overlapping boundaries running from the center vertex 350 light-magenta light-cyan, and radiating out to all other ink color vertices as shown in Figure 4. A non-overlapping approach is preferred so as to eliminate ambiguity as to what region a data point lies within. However, this technique as discussed above, undesirably creates tessellation regions which as illustrated here may span more than half the available luminance range. One example is the region defined by the three vertices white 100, light-cyan 320 and light-magenta light-cyan 350. A region arranged as such means that color halftone dots which land in this region will be made up of smaller spots of the above three colorants. **These three colorants are far enough apart in luminance to create a grainy texture, and be unpleasant and distracting to the eye.** In this example color points 400 and 410 are in this same region as a result of this tessellation

approach even though they are quite far apart in luminance (see from page 7, line 20 – to page 8, line 3, of the Specification as filed).

Figure 5 in support of claim 1, provides a preferred second tessellation approach applied to the same two-dimensional color plane.



With this exemplary non-overlapping tessellation scheme color points 400 and 410 as shown in Figure 5 are now not only in separate regions but those regions have two intervening tessellated regions between them. Color point 400 is in the region delineated by colorants cyan 110, magenta 120, and light-magenta light-cyan 350. Color point 410 is in the region delineated by colorants white 100, light-magenta 310, and light-cyan 320. **The colorants that are now utilized to create the color dots to represent these color points are much closer in luminance and will therefore combine and blend in a manner much more pleasing to the eye.** The redundant ink colorant tessellation as applied here in Figure 5 has been arranged to minimize the range of luminance variation in the regions. **<u>This is achieved by creating region</u>**

boundaries that are predominately orthogonal to the axis of luminance (see page 8, lines 14-25 of the Specification as filed).

The subject matter of independent claim 8, is directed to the utilization of redundant color inks with a methodology for identifying which ink combination from a multitude of possible choices is best utilized in rendering a given image (see page 1, lines 16-18, of the Specification as filed). As is well understood by those skilled in the art, to produce a desired color one can identify a tetrahedron in color space that contains the desired color. One can then produce the desired color by a proper combination of the four vertex colors that define that tetrahedron.

In general, there can be many possible tetrahedra that enclose a given desired color point. As is taught by the Applicant, **the best tetrahedron for such a point is the one that has most nearly the same luminance for all of its vertices**. This will minimize the luminance contrast in the halftone pattern that produces the desired color (see page 6 lines 21-24, of the Specification as filed). So the problem is then to tessellate (divide-up) color space into tetrahedra such that the vertices of the individual tetrahedra have localized luminance values (see page 6 lines 27-28, of the Specification as filed) (in particular page 6 lines 22-23 for support of "vertices").

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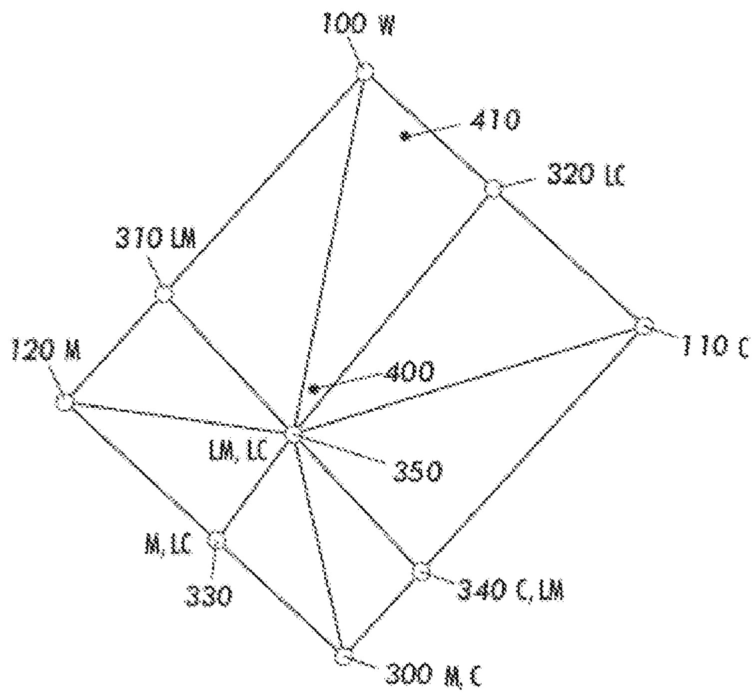

The tessellation employed here consists of breaking-up the color space by defining non-overlapping boundaries running from the center vertex 350 light-magenta light-cyan, and radiating out to all other ink color vertices as shown in Figure 4. A non-overlapping approach is preferred so as to eliminate ambiguity as to what region a data point lies within. However, this technique as discussed above, undesirably creates tessellation regions which as illustrated here may span more than half the available luminance range. One example is the region defined by the three vertices white 100, light-cyan 320 and light-magenta light-cyan 350. A region arranged as such means that color halftone dots which land in this region will be made up of smaller spots of the above three colorants. **These three colorants are far enough apart in luminance to create a grainy texture, and be unpleasant and distracting to the eye.** In this example color points 400 and 410 are in this same region as a result of this tessellation

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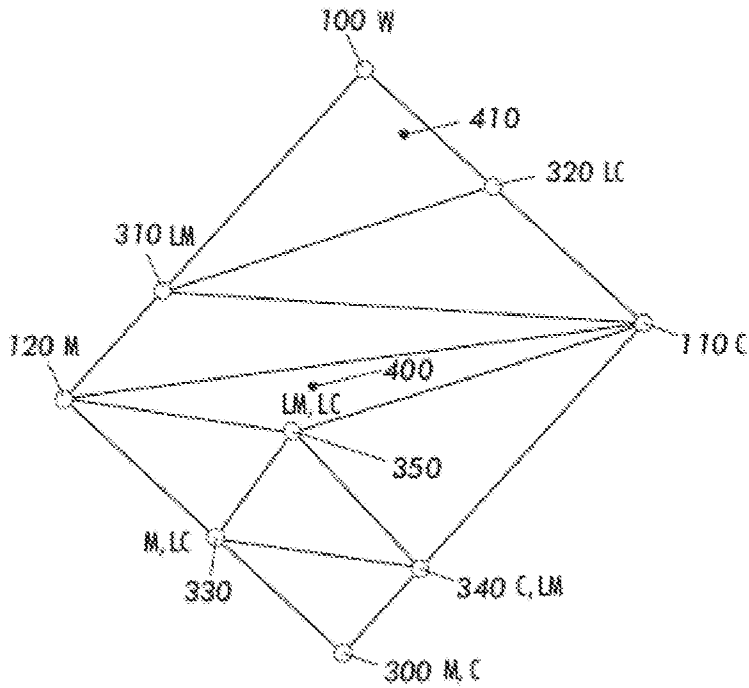
Figure 5 in support of claim 8, provides a preferred second tessellation approach applied to the same two-dimensional color plane.



With this exemplary non-overlapping tessellation scheme color points 400 and 410 as shown in Figure 5 are now not only in separate regions but those regions have two intervening tessellated regions between them. Color point 400 is in the region delineated by colorants cyan 110, magenta 120, and light-magenta light-cyan 350. Color point 410 is in the region delineated by colorants white 100, light-magenta 310, and light-cyan 320. **The colorants that are now utilized to create the color dots to represent these color points are much closer in luminance and will therefore combine and blend in a manner much more pleasing to the eye.** The redundant ink colorant tessellation as applied here in Figure 5 has been arranged to minimize the range of luminance variation in the regions. **This is achieved by creating region**

boundaries that are predominately orthogonal to the axis of luminance (see page 8, lines 14-25 of the Specification as filed).

The subject matter of independent claim 13, is directed to the utilization of redundant color inks with a methodology for identifying which ink combination from a multitude of possible choices is best utilized in rendering a given image (see page 1, lines 16-18, of the Specification as filed). As is well understood by those skilled in the art, to produce a desired color one can identify a tetrahedron in color space that contains the desired color. One can then produce the desired color by a proper combination of the four vertex colors that define that tetrahedron.

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Figure 4 depicts an undesirable tessellation approach applied to a two-dimensional color plane. [The color space has been canted slightly to emphasize the depiction of luminance variation by placing the highest points of luminance at the top, and the lowest points at the bottom of the depiction. The top of the data at vertex 100 being the lightest and the bottom of the diagram at vertex 300 being the darkest end of available luminance variations.] Please note the vertices in Figure 4 and Figure 5 are

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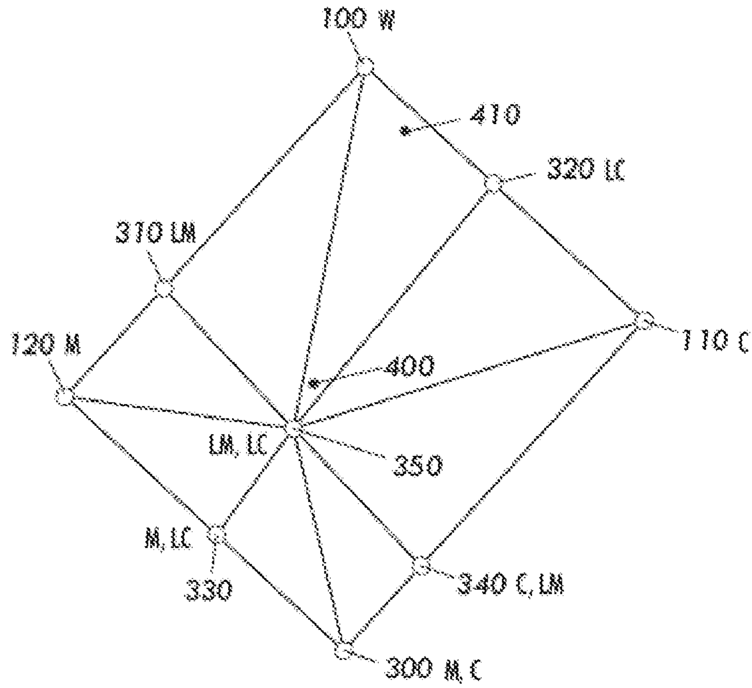

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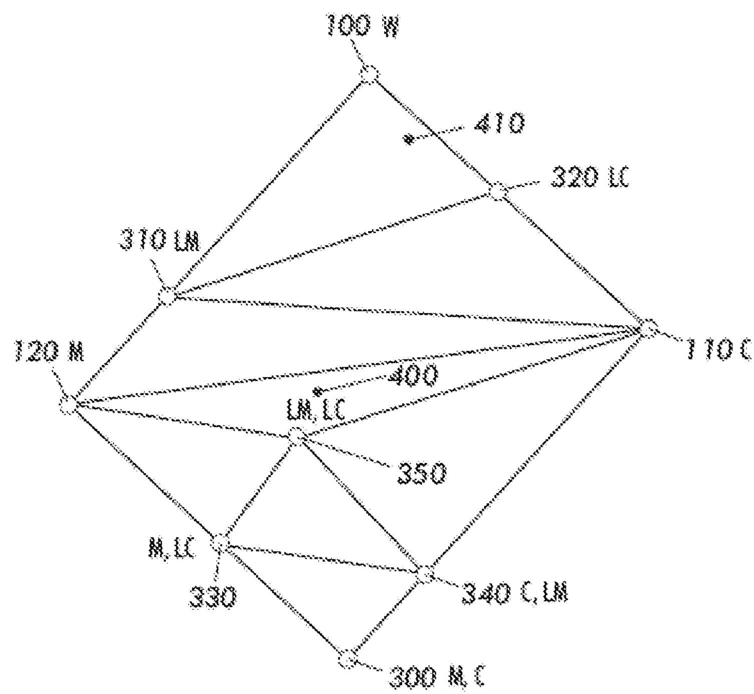

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boundaries that are predominately orthogonal to the axis of luminance (see page 8, lines 14-25 of the Specification as filed).

In more particular support of the subject matter of independent claim 13, the tessellation can be constructed by sorting the color points in order of their luminance and then starting with the darkest point, and adding the points to the set considering each one-by-one. As each point is added, a new triangle is formed from the current three lightest points in the set. If adding the triangle results in a concave shape, then additional triangles must be added to fill the cavity and maintain a convex construction. For a three-dimensional color space this method is generalized to the form tetrahedral volumes from the four lightest points in the set with the addition of each new point. (see page 8, lines 6-14 of the Specification as filed) [in support of claim 13]

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The following grounds of rejection are presented for review:

Claims 1-5 and 7-15 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Application Publication No. 2001/0028471, to Hirokazu (hereinafter Hirokazu) in view of U.S. Patent No. 5,982,990, to Gondek (hereinafter Gondek).

Claim 6 is rejected under 35 U.S.C. §103(a) as being unpatentable over Hirokazu in view of Gondek and U.S. Patent No. 5,185,661, to Ng.

Claim 16 is rejected under 35 U.S.C. §103(a) as being unpatentable over Hirokazu in view of Gondek and U.S. Patent No. 5,390,035, to Kasson.

VII. ARGUMENT

A. Claims 1-5 and 7-15 Would Not Have Been Obvious Over Hirokazu in View of Gondek

Claims 1-5 and 7-15 are rejected under 35 U.S.C. §103(a) as being unpatentable over Hirokazu in view of Gondek.

Hirokazu is provided as disclosing tessellating the available color space into regions. Hirokazu as stated by the Office Action, does not show said color space as defined by redundant color inks, but Gondek does, or so states the Office Action.

Problematically, neither Hirokazu or Gondek, alone or in combination, teach or suggest the Applicant's invention. Thus the Applicant is faced with the conundrum of positively proving a negative. That is, proving that something which is not in there, is not in there.

Hirokazu fails to provide the necessary teaching and claim elements needed to make out the requirements of a prima facie case of obviousness. Hirokazu provides sample discreet spot color mixtures of CMYK as printed upon a proof page, for human visual comparison to a print sheet substrate 80 color [Hirokazu paragraph 44 last sentence] and as such provides color patches which are particular points in color space only. Hirokazu does not tessellate color space into *regions* defined by ***using*** ***as*** ***vertices*** ***each*** **available** **ink** including at least one redundant ink (as the Applicant claims with "by using vertices representing each YMCK and the at least one additional ink, to divide the available color space into

regions"). The spot colors of Hirokazu, indeed even if used as vertices (only seemingly asserted as such in the office action, not as actually taught by Hirokazu) are far too close together in color space and in any case are not at a vertex as defined solely by a single system ink. In other words, Hirokazu does not contemplate or teach dividing up the entire available color gamut available *for a given set of redundant ink colorants*. This is understandably so, as Hirokazu is directed to producing proof sheets for the sake of correcting color highlight profiles where the direct observation of small colorant variations is contemplated and expected, but not the examination of the entire gamut provided by the printer 14. Hirokazu never addresses and thus never solves the problem of what to do with, or when to apply, redundant inks in a print system.

Gondek acknowledges that problem but only solves it empirically. Gondek, while directed to redundant color inks, never-the-less fails to provide for what Hirokazu lacks and vise versa. Indeed Gondek states that the problem (which the Applicant addresses) is to be solved "empirically", (please see the discussion of this in Gondek at column 7, lines 40-57) and thus Gondek teaches away from the Applicant's teaching provided in the present Application Specification and claims. An important indicium of nonobviousness is "teaching away" from the claimed invention by the prior art. <u>In re Dow Chemical Co.</u>, 837 F.2d 469, 473, 5 U.S.P.Q. 2d 1529, 1532 (Fed. Cir. 1988; (unpublished: <u>In re Braat</u>, 16 U.S.P.Q. 2d 1812 (Fed. Cir. 1990)).

The teachings of Hirokazu and Gondek used in combination will only provide the following: <u>proof print-sheets of sample discreet spot color</u>

<u>mixtures as achieved on a page by some combination of CMYK and redundant inks</u>. The combination of Hirokazu and Gondek will still not address the problem of when the print system should switch from utilizing one ink to another ink when redundant inks are available, *except* in an empirical manner. It would thus appear that some of the Applicant's claim language is being ignored while the rest is being applied with impermissible hindsight to the prior art.

There are a number of elements claimed by the Applicants missing in the Hirokazu reference. First, as to CMYK (please note that CMYK, as a term, is simply the re-ordering of the YMCK term claimed by Applicants, YMCK=CMYK), the office action appears to be confusing CMYK as provided by the available printer inks (which is claimed by the Applicants), with CMYK output, as provided for in Hirokazu from a scanner 16 and color separator 18, and used as CMYK image data input ultimately to the printer 14. As an example which will be well understood by one skilled in the art, if the scanner is used to scan a high quality photograph, the resultant scanned color gamut may well exceed printer color gamut which is by definition limited to only the available printer inks! This matters not to Hirokazu, being concerned as he is only with compensating highlight detail shifts. Shifts due to proofing on a paper substrates that differ from the print sheet paper to be used in the actual printing machine (see Hirokazu paragraph 11). Thus the CMYK *input* data of Hirokazu is NOT the same as the Applicants' claimed "available color space as defined by the CMYK inks…".

There are no vertices provided for in Hirokazu or Gondek. Vertices are defined in the <u>American Heritage Dictionary</u> as: "4. *Geometry*. a. The point at which the sides of an angle intersect."

There are provided in Hirokazu instead color patches (see Figure 2 of Hirokazu) which themselves represent particular ***points*** in color space. However, in Hirokazu, these are not points "at which the sides of an angle intersect", and thus are NOT vertices.

Further, Hirokazu does not (nor does Gondek) provide "vertices representing each YMCK…ink" as claimed by the Applicants. The center points provided in Hirokazu, for example color patch 73 of color path group 63 [Hirokazu paragraph 44, second sentence] are directed to L*a*b* defined colors that represent potential print sheet (i.e. paper) colors according to print profile 26 (see paragraphs 36, 37, 38, 39, and 49). Simply stated, these color points are paper sheet colors, NOT ink colors.

Finally, given that the Hirokazu color patches are based on sheet colors, even if the argument that these arrays of close proximity points in color space are deemed as a region (which the Applicants contest) however tiny, they never-the-less fail to provide as claimed by the Applicants, to divide the available color space as defined by the YMCK…inks. That is since by definition, "the color patches vary at small intervals" (see paragraph 43 of Hirokazu) none of these Hirokazu points in color space will ever land on one of the ink vertices. Clustered as they must be, close to the white end of the color space, as most paper is white or very nearly white. Thus they fail to divide the *available* color space as defined by the YMCK…inks. They never reach that far.

Clearly with Hirokazu not teaching or providing so many of the Applicants' claim elements, the requirement for prima facie case of obviousness has not been met.

Nor does Gondek provide for the missing claim elements and teachings that Hirokazu lacks. Indeed as pointed out above, Gondek teaches away from the Applicants' claimed invention.

B. Claim 13 Would Not Have Been Obvious Over Hirokazu in View of Gondek

Claim 13 is rejected under 35 U.S.C. §103(a) as being unpatentable over Hirokazu in view of Gondek.

In dependent claim 13 the Applicants introduce the claim element of "tetrahedral… regions". The office action analogizes this claim distinction as being met with regions "defined by a constant L* value, a range of a* values, and a range of b* values, which form a four-sided region (such as figure 2(61) of Hirokazu), and thus a tetrahedron. [see page 7, third paragraph, second sentence of the 01/07/2008 Office Action]. Indeed examination of Figure 2 of Hirokazu shows a five by five array of 25 patch colors which indeed could be considered to provide a two-dimensional, four sided square or rectangle. However, it would appear that the Office action is confusing sides with faces. The American Heritage Dictionary defines tetrahedron as: "A polyhedron with four ***faces***." As is understood by those with a background in geometry, a tetrahedron is a simple volumetric shape which by definition is comprised of four faces which thereby must be triangular in shape (three sides). A square or rectangle can never be used in defining a tetrahedron.

Clearly Hirokazu cannot be teaching the Applicants' claimed element of a tetrahedron and thus with this yet additional missing claim element the requirement for prima facie case of obviousness has not been met.

VIII. CONCLUSION

For all of the reasons discussed above, it is respectfully submitted that the rejections are in error and that claims 1-16 are in condition for allowance. While claims 6 and 16 have not been separately argued, they depend from claims deemed allowable, thus they should be allowable as well. For all of the above reasons, Appellants respectfully request this Honorable Board to reverse the rejections of claims 1-16.

Respectfully submitted,

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Filed: November 25, 2008

CLAIMS APPENDIX

CLAIMS INVOLVED IN THE APPEAL:

1. (Previously Presented) A method for utilizing additional color inks in a printing system, comprising:

receiving image data as input into a color printing system having YMCK inks and at least one additional color ink;

tessellating an available color space as defined by the YMCK inks and at least one additional color ink, by using vertices representing each YMCK and the at least one additional ink, to divide the available color space into regions where the regions are arranged so as to minimize the range of luminance variation found within the regions; and,

applying the resultant tessellated available color space in the selection of the amounts of the YMCK inks and the at least one additional color ink to the rendering of the image data.

2. (Previously Presented) The method of claim 1 further comprising:

overlaying the tessellated color space result from the prior tessellating step with interpolation points so as to create an overlay lookup table.

3. (Previously Presented) The method of claim 2 further comprising:

applying image data to the overlay lookup table to point to which additional color inks to select and provide the amounts to use of the selected additional color inks.

4. (Original) The method of claim 1 wherein the regions are arranged so that region boundaries are predominately orthogonal to the axis of luminance.

5. (Original) The method of claim 3 wherein the amounts are interpolated from the interpolation points stored in the overlay lookup table.

6. (Original) The method of claim 5 wherein the interpolation is performed by calculating the volume of tetrahedra formed by the interpolation points.

7. (Original) The method of claim 1 wherein the regions are non-overlapping.

8. (Previously Presented) A method in a printing system having YMCK inks, for utilizing additional color inks providing a given resultant color space, comprising:

receiving image data as input into a redundant color printing system having YMCK inks and additional color inks;

tessellating into regions the given resultant color space so as to minimize luminance variation in the regions as defined by the YMCK and additional color inks utilized; and,

applying the resultant tessellated regions in the selection of the amounts of the YMCK inks and additional color inks to the rendering of the image data in the redundant color printing system.

9. (Previously Presented) The method of claim 8 wherein the tessellation is achieved by:

sorting the YMCK and additional color inks by order of luminance from the darkest to the lightest,

adding the YMCK and additional color inks as points to the color space and connecting the points in the sorted order so as to create tetrahedral tessellated regions.

10. (Original) The method of claim 9 wherein the regions are non-overlapping.

11. (Previously Presented) The method of claim 10 further comprising:

overlaying the tessellated color space with interpolation points so as to create an overlay lookup table.

12. (Previously Presented) The method of claim 11 further comprising:

applying image data to the overlay lookup table to point to which redundant color inks to select and provide the amounts to use of the selected redundant color inks.

13. (Previously Presented) A method for utilizing YMCK and additional color inks having a given resultant color space for rendering image data in a printer, comprising:

receiving image data as input into a redundant color printing system having YMCK inks and at least one additional color ink;

tessellating the given resultant color space into regions so as to minimize luminance variation in the regions, the regions delineated by vertices representing each YMCK ink and the at least one additional color ink by:

sorting the delineated vertices as defined by each YMCK ink and the at least one additional color ink by order of luminance from the darkest to the lightest and

connecting the delineated vertices as defined by YMCK inks and redundant color inks in the sorted order across the color space so as to create tetrahedral non-overlapping tessellated regions with borders which are as much as possible predominately orthogonal to the axis of luminance; and,

applying the resultant tessellated color space regions in the selection of the amounts of the YMCK inks and the at least one additional color ink to the rendering of the image data in the redundant color printing system.

14. (Previously Presented) The method of claim 13 further comprising:

overlaying the tessellated color space with interpolation points so as to create an overlay lookup table.

15. (Previously Presented) The method of claim 14 further comprising:

applying image data to the overlay lookup table to point to which YMCK inks and the at least one additional color ink to select and provide the amounts to use of the selected YMCK inks and the at least one additional color ink color inks.

16. (Original) The method of claim 13 wherein if creating a tetrahedral non-overlapping tessellated region results in a concave shape then additional tetrahedral non-overlapping tessellated regions are added to fill the cavity and maintain a convex construction.

EVIDENCE APPENDIX

NONE

RELATED PROCEEDINGS APPENDIX

NONE